Exchange Rate Misalignment and Its Effects on Agricultural Producer Support Estimates (PSEs) in India

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Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

ABSTRACT

This paper examines the effects of the exchange rate misalignment on the agricultural Producer Support Estimates (PSEs) in India. Based on various time series techniques, the equilibrium exchange rate of the Indian rupee and the corresponding misalignment are estimated and applied to the calculations of the PSEs. Our results show that the indirect effect from exchange rate misalignment on India's agriculture has either amplified or counteracted the direct effect from sectoral-specific policies. The indirect effect of exchange rate overvaluation has potentially taxed the agricultural sector in India during the periods leading up to the financial crisis. However, the magnitude of these indirect effects becomes smaller in the later periods when the actual exchange rate moves closer to its equilibrium value.

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1. Introduction

Agricultural policies in the developing countries play a very important role in determining domestic commodity prices and the returns to agriculture. The nature and degree of the policy interventions differ across countries thereby producing different types of impact on producers and consumers. Various agricultural policy indicators (APIs) such as the Producer Support Estimates (PSEs) have been constructed to evaluate and monitor these policy changes (Josling and Valdes, 2004).

A problem with conventional analyses based on the APIs, however, is that they usually have a sector-specific focus that can miss the important linkages between economy-wide policies and the agricultural sector. By changing the relative prices of importables, exportables, and home goods, some economy-wide policies, such as the exchange rate policies, can have impacts on agricultural incentives that might overwhelm those from sectoral policies. The different effects of sectoral and economy-wide policies on agriculture in the developing countries were documented in a classic series of studies by Krueger, Schiff and Valdes (1988 and 1991).

The relevance of exchange rates in the PSE estimates has been pointed out by a number of authors including Harley (1996), Liefert et al. (1996) and Melyukhina (2002). This issue is particularly important for the developing countries since capital surges, macroeconomic instability and subsequent financial crisis in the last two decades, together with delayed or insufficient adjustments in the exchange rates, have generated substantial exchange rate misalignments in some of these countries. Pronounced misalignments in the exchange rate could potentially subsidize or tax the agricultural sector and lead to incorrect estimates of the level and sometimes the direction of agricultural support as measured by the PSEs. In these cases, the effects of exchange rate misalignments have to be taken into account if meaningful calculations of the PSE are to be presented.

Using various time series methods, the current study attempts to estimate exchange rate equilibrium and disequilibrium and identify its effects on the PSEs in India, a country where issues of exchange rate misalignment and its effects on the agricultural support levels have been important but nonetheless received little attention. The paper is organized as follows. Section 2 empirically estimates exchange rate equilibrium and misalignment in India. Section 3 discusses the effect of exchange rate misalignment on the PSEs. Summary and conclusions are provided in section 4.

2. Exchange Rate Equilibrium and Misalignment in India

Literature Review

There is no simple answer to what determined the equilibrium exchange rate. The fundamental difficulty is that the equilibrium value of the exchange rate is not observable which is further complicated by the fact that there exist a variety of models that can be used to determine it. Common approaches for equilibrium exchange rate determination range from the simple PPP to more sophisticated models such as the Fundamental Equilibrium Exchange Rate (FEER) (Williamson, 1994), the Natural Real Exchange Rate (NATREX) (Stein, 1994), the Behavioral Equilibrium Exchange Rate (BEER) (Clark and MacDonald, 1999) and the Real Equilibrium Exchange Rate (REER) (Edwards, 1989 and 1994; Hinkle and Montiel, 1999).

The equilibrium exchange rate for the Indian rupee has been modeled by a number of authors using different approaches. Kholi (2002 and 2003) calculates the equilibrium (nominal) exchange rate of the Indian rupee for post-floating years using the PPP with a base rate set at the

1993 level. Results from the studies show that the nominal exchange rate has been persistently overvalued during the sample period. Pantnaik and Pauly (2000 and 2001) use a variant of the BEER approach to derive the equilibrium exchange rate in India. Their results suggest that in the 1990s the rupee was essentially determined by equilibrium in the output market. However, due to slow adjustments in this market, the exchange rate was not always at the equilibrium rate. Despite periods when the rupee was overvalued or undervalued compared to the long run rate, usually in response to forces in financial markets, there appeared to be a clear tendency to revert to the equilibrium level. Cerra and Saxena (2002) apply REER approach to study whether the India rupee was misaligned before the 1991 crisis through a vector error correction model. The evidence from this study indicates that the Indian rupee was overvalued in the late 1980s and early 1990s. The overvaluation played a significant role in the crisis and caused the sharp exchange rate depreciation. Cerra and Saxena also show that the vector error correction (VEC) model performs better than a random walk model in terms of out-of-sample forecast.

Following Cerra and Saxena (2002), this paper adopts the REER approach where the real exchange rate is determined by a set of economic fundamentals. The set of fundamentals that may be identified (by theory) includes the following four categories: (1) Domestic supply-side factors; (2) Fiscal policies; (3) International economic environment; (4) Commercial policies. Time series methods including the Johansen's cointegration approach are used to establish the long-run relationship between the exchange rate and the economic fundamentals.

<u>Variable Description</u>

A system of variables $\mathbf{x}_t$ consisting of the real exchange rate and the underlying fundamentals is formulated as $\mathbf{x} = [LRER, LPRO, LGEX, WIR, LTOT, LOPN]$ with the definition of each variable given below. Note that all variables are in logarithmic forms (denoted by L in front of each variable) except for the world interest rate (*WIR*). When index numbers are relevant, the base year is set at 2000. Annual data from 1950-2003 are drawn from the *International Financial Statistics* of the IMF and supplemented by various issues of *Handbook of Statistics on Indian Economy* published by the Reserve Bank of India.

The real exchange rate (*LRER*) is defined as the product of nominal exchange rate and the ratio of the consumer price indexes: $LRER = \ln\left(e \cdot CPI^{US} / CPI\right)$, where e is the nominal exchange rate, CPI^{US} and CPI are US and India's consumer price indexes, respectively. While some studies have used the multilateral *real effective exchange rate*, the real exchange rate defined here is a bilateral rate expressed in domestic currencies per US dollar (an increase represents depreciation). The reason for using a bilateral rate is that it can be easily applied to the later PSE calculations as the world commodity prices are generally denominated in US dollars.

The Balassa-Samuelson effect caused by differential productivity growth in the traded good vs. non-traded good sectors (*LPRO*) is used to represent supply-side factor. Following Cerra and Saxena (2002), this variable is proxied by the log of annual growth of the industrial production index (*IPI*): $LPRO = \ln(IPI/IPI_{-1})$. The government expenditure (*GEX*) as a percentage to the GDP is used to capture the effect of fiscal policies: $LGEX = \ln(GEX/GDP)$.

Two variables are defined to capture changes in international economic environment. First the real world interest rate (*WIR*) is used, which is approximated by the US real interest rate calculated by subtracting the US inflation rate (percent change in the CPI^{US}) from the 1-year Treasury-Bill rate (*TBR*): $WIR = TBR - (CPI^{US} - CPI_{-1}^{US}) / CPI_{-1}^{US}$. The second variable in this category is the terms of trade (*LTOT*). It is defined as the ratio of export price index (export unit value *XUV*) to import price index (import unit value *MUV*): $LTOT = \ln\left(XUV/MUV\right)$.

Finally, the openness (*LOPN*) representing commercial policies is calculated as the ratio of the sum of imports (*VM*) plus exports (*VX*) to the GDP: $LOPN = \ln\left((VM + VX)/GDP\right)$. Openness reflects how connected the economy is to the rest of the world and stands for trade liberalization. Its use as a proxy for trade policy is justified because of the difficulty of obtaining good time series data on import tariff and export subsidy and also because it may account not only for explicit trade policy but also for implicit, though very important, factors such as quotas and exchange controls (Elbadawi and Soto, 1994).

<u>The Unit Root and Cointegration Tests</u>

The order of integration for each univariate series is determined using the augmented Dickey-Fuller (ADF) test. The ADF test statistic is obtained from the following regression model:

$$(1)\ \Delta x_t = \alpha_0 + \alpha_1 x_{t-1} + \gamma t + \sum_{i=1}^{p} \beta_i \Delta x_{t-i} + \varepsilon_t$$

where Δ is the first difference, x_t represents each of the variables in the vector $\mathbf{x}_t$, and p is the lag length. Table 1 reports the ADF unit root test results with different test specifications and the Phillips-Perron (PP) *Z*-tests are presented for comparison. The ADF and PP tests show that that all the variables in $\mathbf{x}_t$ are I(1) in levels and I(0) in differences except *LPRO*, which seems to be trend stationary.[1]

The Johansen maximum likelihood method (Johansen, 1991) is used to test for cointegration. The Johansen procedure is based on the following *p*th-order VEC model:

$$(2)\ \mathbf{\Delta x}_t = \mathbf{\Gamma}_1 \mathbf{\Delta x}_{t-1} + \mathbf{\Gamma}_2 \mathbf{\Delta x}_{t-2} + \ldots + \mathbf{\Gamma}_{p-1} \mathbf{\Delta x}_{t-p+1} + \mathbf{\Psi x}_{t-1} + \mathbf{\Pi D}_t + \boldsymbol{\varepsilon}_t$$

[1] The rejection of a unit root may result from small lag lengths, which adversely affect the size of the tests. When additional lags are included, the null hypothesis of a unit root cannot be rejected for this variable.

where $\mathbf{x}_t$ is a $(n \times 1)$ vector of non-stationary I(1) variables, $\mathbf{\Gamma}_i$, $\mathbf{\Psi}$ and $\mathbf{\Pi}$ are $(n \times n)$, $(n \times n)$ and $(n \times k)$ coefficient matrices, $\mathbf{D}_t$ is a $(k \times 1)$ vector of deterministic terms and $\boldsymbol{\varepsilon}_t$ is a vector of error terms.

Suppose that $rank(\mathbf{\Psi}) = h,\ 0 < h < n$ and there are *h* cointegrating relationships in $\mathbf{x}_t$. It implies that $\mathbf{\Psi}$ can be written in the form

(3) $\mathbf{\Psi} = \mathbf{AB}'$

for **A** an $(n \times h)$ matrix and $\mathbf{B}'$ an $(h \times n)$ matrix. The Johansen procedure provides two tests, the trace and the maximal eigenvalue tests, for the number of linearly independent cointegrating relationships among the series in $\mathbf{x}_t$;

(4) $\lambda_{trace}(h) = -T \sum_{i=h+1}^{n} \ln(1 - \hat{\lambda}_i)$ and $\lambda_{\max}(h, h+1) = -T \ln(1 - \hat{\lambda}_{h+1})$

where $\hat{\lambda}_i$ are the estimated eigenvalues of matrix $\mathbf{\Psi}$.

Before proceeding with the Johansen test, the model is adjusted by taking into account short-run shocks. We follow Edwards (1989) by defining an exogenous variable that capture macroeconomic policy, *LDCT*, the log of domestic credit (*DCT*) over GDP: *LDCT*= ln(*DCT/GDP*) and including its first difference, $\Delta LDCT$, in $\mathbf{D}_t$. In addition to this, a vector of dummy variables is also included. The vector contains three dummy variables representing two oil price shocks in the 1970s and the balance of payment crisis and the merge of the dual exchange rate in the early 1990s.[2]

Table 2 present the Johansen cointegration tests under two cases: without and with a deterministic time trend (Case I and Case II). The λ_{trace} and $\lambda_{\max}$ statistics reject the null

[2] The dummy variables take the value of 1 in years 1973 (Dummy1), 1979 (Dummy2) and 1991, 92, 93 (Dummy3) respectively, and 0 otherwise.

hypothesis of zero cointegrating rank at the 0.05 significance level for each case. However, the null hypothesis that the cointegrating rank is at most 2 is accepted indicating that there are up to two cointegrating relationships among the variables ($h = 2$).

Exchange Rate Equilibrium and Misalignment

As is now well known in the literature, the existence of multiple cointegrating vectors complicates the interpretation of the equilibrium in the exchange rates (Clark and MacDonald, 1999). What the Johansen procedure provides is information on how many cointegrating vectors *span* the cointegrating space, while any linear combination of the vectors can itself be a cointegrating vector. If two cointegrating vectors are estimated to exist and the exchange rate variable (*LRER*) appears in both vectors, then each cointegrating vector or any linear combinations of the two can equally be treated as equilibrium exchange rate relationships.

However, a likelihood ratio test developed by Johansen and Juselius (1990):

(5) $$-2\ln\left(\hat{L}_R / \hat{L}_U\right) = -2\ln\left(Q\right) = T\sum_{i=1}^{\hat{h}} \ln\left\{\frac{\left(1-\hat{\lambda}_i^*\right)}{\left(1-\hat{\lambda}_i\right)}\right\}$$

where *R* and *U* denoting restricted and unrestricted models shows that a joint restriction on **B** and **A** in the form: $\mathbf{B}' = \begin{bmatrix} * & * & * & * & * & * \\ 0 & * & * & * & * & * \end{bmatrix}$ and $\mathbf{A}' = \begin{bmatrix} * & * & * & 0 & * & * \\ * & * & * & 0 & * & * \end{bmatrix}$ is not rejected at 5% significance level with $\chi^2(2) = 1.93$ (p-value $= 0.38$). In light of this joint test, the 1st (unrestricted) cointegrating vector which contains the exchange rate can be recognized as the equilibrium exchange rate relationship with the 2nd (restricted) cointegrating vector representing a different relationship for variables excluding the exchange rate. Meanwhile, the world interest rate (*WIR*) can be treated as weakly exogenous to the system. Table 3 presents the restricted cointegration results normalizing on *LRER* and *LPRO* for the 1st and 2nd cointegrating vector, respectively.

As the economic fundamentals may themselves be out of the equilibrium, a Hodrick-Prescott (H-P) filtering technique is applied to obtain their steady-state values (Hodrick and Prescott, 1997). The coefficient λ in the H-P is chosen to be equal to 10 to match our annual data series. The filtered values of the economic fundamentals as well as the restricted cointegration results are then used to calculate the equilibrium exchange rate. Of particular interest to this analysis is the movement of the currency in the recent two decades and Figures 1 compares the actual with the equilibrium exchange rate with the difference between the two indicating the exchange rate misalignment.

3. Effect of Exchange Rate Misalignment on the PSE

<u>The PSE</u>

According to the OECD, the PSE is "an indicator of the annual monetary value of gross transfer from consumers and taxpayers to agricultural producers." In nominal terms the PSE for all agricultural producers is the sum of total Market Price Support (*MPS*) and aggregate budgetary payments (*BP*). The calculation of total *MPS*, according to the OECD approach consists of three steps. First, a nominal value of *MPS* is estimated for individual products, the set of which is known as the covered "*MPS* commodities":

(6) $MPS_j = \left(P_j^d - P_j^{ar}\right)Q_j$

where *j* denotes commodity, P_j^d is the domestic price, P_j^{ar} is the adjusted reference price, and Q_j is the quantity. The adjusted reference price P_j^{ar} is the world market price (either a relevant import c.i.f. price or export f.o.b. price depending on whether the commodity is an importable or an exportable) expressed in domestic currency and adjusted by various transaction costs.[3] The cost adjustment process also differs by the commodity's trade status (see Mullen, et al., 2004 for details), but in either case, the adjusted reference price can be expressed as:

(7) $P_j^{ar} = P_j^w \times E + ADJ_j$

where P_j^w is the world market price, E is the nominal exchange rate, and ADJ_j is the domestic cost adjustment factor.

The second step is to sum the product-specific MPS results into an MPS_c for the covered commodities (denoted by letter *c*): $MPS_c = \sum MPS_j$. In the third step the MPS_c for covered commodities is "scaled up" to all products based on the share (k) of the covered commodities in the total value of agricultural production. The final step or "*MPS* extrapolation procedure" can be expressed as: $MPS = MPS_c/k$, where *MPS* is the estimated total market price support. With the scaling-up, the OECD "Total PSE" is calculated as $PSE = MPS + BP$. Without the scaling-up the total PSE is $PSE_c = MPS_c + BP$. The PSE measure can be expressed on a percentage basis (denoted by $\%PSE_c$ and $\%PSE$ for non-scaling-up and scaling-up, respectively) using $(VOP + BP)$ as the denominator, where *VOP* is the total value of agricultural production at domestic producer prices: $\%PSE_c = \frac{MPS_c + BP}{VOP + BP}$ and $\%PSE = \frac{MPS_c / k + BP}{VOP + BP}$. This analysis reports the results based on the percentage PSE.

Following the terminology of Krueger, Schiff and Valdes (1988), we define three types of effects using the percentage PSE. The "direct effect" induced by sector-specific policies is defined as percentage PSE calculated using the actual nominal exchange rate *E*, the "total effect"

[3] Byerlee and Morris (1993) point out that the conventional methods of comparing the domestic price to an import or export adjusted reference price can sometimes lead to an incorrect estimate of protection. They argue that the selection of a relevant reference price (P^{ar}) depends on the relationship between the autarky equilibrium price and the adjusted reference prices for imports and exports (see also Mullen, et al., 2004).

induced by both sectoral and exchange rate policies is defined as the percentage PSE calculated using the equilibrium exchange rate E^*, and the difference between the two captures the "indirect effect" of misalignment of the exchange rate. Without scaling-up, these effects are:

$$\text{(8a) Direct Effect} = \%PSE_c(E) = \frac{MPS_c(E)+BP}{VOP+BP} = \frac{\sum\left(P_j^d - P_j^{ar}(E)\right)Q_j + BP}{\sum P_j^d Q_j + BP}$$

$$\text{(8b) Total Effect} = \%PSE_c(E^*) = \frac{MPS_c(E^*)+BP}{VOP+BP} = \frac{\sum\left(P_j^d - P_j^{ar}(E^*)\right)Q_j + BP}{\sum P_j^d Q_j + BP}$$

$$\text{(8c) Indirect Effect} = \%PSE_c(E^*) - \%PSE_c(E) = \frac{\sum\left(P_j^{ar}(E) - P_j^{ar}(E^*)\right)Q_j}{\sum P_j^d Q_j + BP}$$

With scaling-up, we simply replace $\%PSE_c$ with $\%PSE$ and the MPS_c measure with MPS_c/k in (8a-c). It is evident that the impact of scaling-up on the support level (direct and total effects) depends on the sign of MPS_c: if MPS_c is negative, then the scaling-up will indicate more disprotection and if MPS_c is positive, the scaling-up will indicate more protection. It is also easy to show that the scaling-up magnifies the indirect effect without scaling-up by exactly $1/k$, the inverse of the share of covered commodities in the total value of agricultural production.

Ignoring domestic cost adjustment (ADJ_j), it can be shown that the indirect effects in the non-scaling-up and scaling-up cases are $\frac{m}{1+m}\cdot\frac{\sum P_j^w EQ_j}{VOP+BP}$ and $\frac{1}{k}\frac{m}{1+m}\cdot\frac{\sum P_j^w EQ_j}{VOP+BP}$, respectively, where m is the percentage exchange rate misalignment, $m = \left(E - E^*\right)/E^*$.[4] For exchange rate misalignment $|m| < 1$, the indirect effect is negative if overvaluation occurs ($m < 0$); positive if undervaluation occurs ($m > 0$); and zero if no misalignment exists ($m = 0$).

[4] Ignoring the domestic cost adjustment (ADJ_j) simplifies the expressions for the indirect effect. However, in the later PSE calculations, the ADJ_j is taken into account.

The Three Effects in India

To evaluate the direct, total and indirect effects for India, a recent analysis by Mullen, Orden and Gulati (2005) is drawn. The actual nominal exchange rates are the annual average official rates and the nominal equilibrium exchange rates are derived from the corresponding real equilibrium rates from Section 2.[5] The calculations are undertaken for 11 covered commodities including wheat, rice, corn, sorghum, sugar, groundnut, rapeseed, soybeans, and sunflower, chickpeas, and cotton. Following Mullen, Orden and Gulati (2005), the PSE for six commodities (wheat, rice corn, sorghum, groundnuts and sugar) are calculated using the Byerlee and Morris (1993) procedure in determining the reference prices (see footnote 3), while rapeseed, soybeans, sunflower, chickpeas and cotton are assumed to be importable for all years. Table 4 shows the direct, indirect and total effects measured by the PSE for the period of 1985-2002.

The sample period 1985-2002 is divided into four distinct subperiods for the presentation of our results. Period one (I) covers 1985-1988 when the exchange rate started to overvalue with an average overvaluation of -8.6 percent. Period two (II) represents a sustained overvaluation period from 1989 to 1992 during which the crisis occurred and the exchange rate was under active adjustment. The overvaluation in this period was -11.8 percent. Period three (III) is a slight undervaluation period from 1993-1998 with an undervaluation of 3.6 percent. The last period (IV) is the stable exchange rate period from 1999-2002 when the actual exchange rate is close to the equilibrium rate with a slight overvaluation of -2.8 percent.

The numbers in the rows of direct effect in Table 4 are equivalent to the conventional measures of the PSE. On average, the agricultural protection or disprotection measured by the direct effect has shown a counter-cyclical pattern in India. With or without scaling-up, the direct

[5] Specifically, the nominal equilibrium exchange rate is obtained by multiplying the real equilibrium exchange rate by the ratio of India's CPI to US CPI.

effect was positive when world commodity prices were low during the first period (I) but turned to disprotection when the world prices strengthened in the mid-1990s (period III). The world prices have since then followed a downward trend, and in the most recent period (IV), the direct effect shows an increase in support. The same pattern can be observed for the total effect. These results are consistent with Mullen, Orden and Gulati (2005), who report their PSE results on an annual basis.[6]

The indirect effect caused by exchange rate misalignments has had quite different impacts on India's agriculture in comparison to the direct effect. On average India's agricultural sector has been indirectly penalized by exchange rate overvaluation in periods I, II and IV, but subsidized by exchange rate undervaluation in period III. The indirect effect counteracted the direct effect in periods I, III and IV, but reinforced it in period II. The indirect effect was greater in the years before and during the crisis when the exchange rate was continuously misaligned, which in period II averaged about -8 percent and -19 percent for the non-scaling-up and scaling-up, respectively. In the post-crisis years, as the result of decreased magnitude of exchange rate misalignment following macroeconomic restructuring, the indirect effect has dampened down to around 1-3 percent. The scaling-up has had a uniform impact on the indirect effect for each period, which more than doubles in the scaled-up than the non-scaled-up case. The reason for this is that the share of covered commodities in total value of production is about 0.45 for each of the periods.

Noticeably however, the indirect effect of the exchange rate is smaller in absolute value than the direct effect in periods I, III and IV, indicating the dominance of sectoral-specific policies over economy-wide policies (exchange rate in this case). The opposite happened in

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[6] Some slight differences exist since the actual exchange rates used in this study are calendar-year average official exchange rates while they are often harvest season average official rates in Mullen, Orden and Gulati (2005).

period II. This result is somewhat different from that of Krueger, Schiff and Valdes (1988 and 1991) in which they found that the economy-wide policies such as the exchange rate play a more dominant role across a range of developing countries (not including India) in an earlier period up to the mid-1980s.

4. Summary and Conclusions

The level of the exchange rate and its disequilibrium can have significant impacts on the agricultural sector. Although there are repeated claims and indeed widespread agreement that exchange rate misalignments can lead to inaccurate calculations of the support measures, empirical studies on the issue have been scant. There have been attempts to consider the role the exchange rate plays in more comprehensive agricultural policy indicators such as the PSEs, but the calculations usually use simple adjustment approaches such as the PPP. In this analysis, an alternative approach to determining equilibrium exchange rates is proposed and then applied to the evaluation of the PSE in India.

The main findings from the PSE calculations indicate that the indirect effect of exchange rate either counteracts or reinforces the direct effect of sectoral policies. The indirect effect of exchange rate overvaluation has potentially taxed the agricultural sector in India during the period 1985-1992 and 1999-2002. However, the magnitude of these indirect effects becomes smaller in the later periods when the actual exchange rate moves closer to its equilibrium value. It should be noted that the domestic prices are fixed in this analysis even though alternative exchange rates are applied. However, when exchange rate changes pass-through occurs, the results presented here will be different.

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Table 1: The Unit Root Test Results

Variable	Test Statistics					
	τ	$Z(\tau)$	τ_{μ}	$Z(\tau_{\mu})$	τ_{τ}	$Z(\tau_{\tau})$
				Levels		
LRER	1.32	1.61	-0.30	-0.20	-2.15	-1.89
LPRO	-1.87	-1.75	-5.47**	-4.69**	-5.45*	-4.63**
LGEX	-2.09*	-2.40*	-2.13	-2.48	-2.27	-2.54
WIR	-0.70	-0.76	-1.64	-1.82	-1.07	-1.22
LTOT	-0.10	-0.55	-3.27*	-2.77	-3.55*	-2.83
LOPN	-0.60	-0.84	-0.26	-0.41	-2.38	-1.74
				First Differences		
LRER	-4.94**	-5.86**	-5.22**	-6.02**	-5.32**	-6.01**
LPRO	-4.27**	-24.74**	-4.21**	-24.48**	-4.15**	-25.28**
LGEX	-5.99**	-7.88**	-6.62**	-8.31**	-7.11**	-8.39**
WIR	-4.87**	-5.70**	-4.81**	-5.61**	-5.10**	-7.06**
LTOT	-4.91**	-9.73**	-4.86**	-9.55**	-4.87**	-13.51**
LOPN	-5.71**	-9.16**	-5.74**	-9.07**	-6.34**	-10.56**

Note: 1) **1% significance level, *5% significance level.

2) The test statistics τ , τ_{μ}, τ_{τ} and $Z(\tau)$, $Z(\tau_{\mu})$, $Z(\tau_{\tau})$ are ADF and PP tests respectively and correspond to three type of specifications: (i) no trend and no intercept; (ii) intercept only; and (iii) trend and intercept.

3) The lag length *p* of the ADF test is set by the AIC in every case. The PP test is based on Newey-West bandwidth selection using Bartlett kernel.

Table 2: Johansen Cointegration Test Results

Null Hypothesis	Case I				Case II			
	λ_{trace} test	λ_{trace} (0.95)	$\lambda_{\max}$ test	$\lambda_{\max}$ (0.95)	λ_{trace} test	λ_{trace} (0.95)	$\lambda_{\max}$ test	$\lambda_{\max}$ (0.95)
$h = 0$	151.55*	103.85	68.56*	40.96	147.86*	95.75	68.26*	40.08
$h \leq 1$	82.99*	76.97	38.82*	34.81	79.61*	69.82	38.32*	33.88
$h \leq 2$	44.18	54.08	20.60	28.59	41.29	47.86	20.60	27.58
$h \leq 3$	23.58	35.19	10.65	22.30	20.69	29.80	10.60	21.13
$h \leq 4$	12.92	20.26	9.60	15.89	10.09	15.49	9.23	14.26
$h \leq 5$	3.33	9.16	3.33	9.16	0.87	3.84	0.87	3.84
D	Constant and Short-run Shocks				Constant and Short-run Shocks			
Lag Length	2				2			
Sample	1950-2003				1950-2003			

Note: * denotes rejection at 5% significance level. Case I: no intercept in the cointegrating equation or the VEC; Case II: intercept in the cointegrating equation and the VEC. *h* is the cointegrating rank. The lag-length of two is determined by a battery of diagnostic tests on the unrestricted VAR including a x^2 test for the hypothesis that the *i*-period lag is zero for each equation separately; a joint *LM* test for the hypothesis that there is no heteroskedasticiy or serial correlation; and a joint x^2 test for the normality of the errors.

Table 3: Restricted Cointegration Results

	LRER	*LPRO*	*LGEX*	*WIR*	*LTOT*	*LOPN*	Constant
B′							
	1.000	10.370**	-0.621**	-2.695**	-0.569**	-0.654**	-4.037
		(1.345)	(0.078)	(1.104)	(0.184)	(0.076)	
	0.000	1.000	-0.042**	0.548**	0.031*	0.030**	-0.250
			(0.008)	(0.100)	(0.018)	(0.007)	
A′							
	-0.017**	-0.015**	0.016*	0.000	0.049**	0.040**	--
	(0.008)	(0.006)	(0.008)		(0.020)	(0.015)	
	0.011	0.002	0.019**	0.000	-0.011	-0.041*	--
	(0.022)	(0.010)	(0.003)		(0.032)	(0.025)	

Note: 1) Standard errors are in parentheses.
2) ** and * denote significance at 5 and 10 percent levels.

Table 4: Direct, Indirect and Total Effect by PSE

Period	1985-88 I	1989-92 II	1993-98 III	1999-02 IV
(%Misalignment)	(-8.6%)	(-11.8%)	(3.6%)	(-2.8%)
%PSE$_c$	Non-scaling-up			
Direct	7.7	-0.8	-2.9	9.0
Indirect	-3.2	-8.2	1.4	-1.3
Total	4.5	-9.0	-1.5	7.7
%PSE	Scaling-up			
Direct	12.1	-3.6	-16.2	10.9
Indirect	-6.9	-19.4	3.1	-3.2
Total	5.2	-23.0	-13.1	7.7

Note: Percent exchange rate misalignment for each period is in parentheses.

Figure 1: The Actual and Equilibrium Real Exchange Rates